EUROPEAN MARS SOCIETY COFERENCE

14-16th October 2016

Plant growth in Space: constraints and challenges

Veronica De Micco[1], Giovanna Aronne[1], Carmen Arena[2] and Stefania De Pascale[1]*

[1] Department of Agricultural Sciences, University of Naples Federico II

[2] Department of Biology, University of Naples Federico II

**Speaker*

In the framework of sustaining human space exploration, the development of Closed Ecological Life Support Systems (CELSS) based on living organisms is crucial to regenerate all resources to sustain human needs. Higher plants are the most promising biological regeneration components because they not only have a role in air regeneration, water and wastes recycling, but also furnish fresh food.

Plant growth in Space can be constrained by: a) the direct action of the same environmental factors as on Earth but acting at different levels in Space; b) the direct impact of new factors; c) the indirect action of new factors modifying the availability of liquid and gaseous resources. Among the new factors, microgravity and ionizing radiation have been the most studied both in Space and in simulated space conditions. The effect of microgravity has been deeply analyzed in reference to specific aspects of plant growth (e.g. gravitropism, cell wall development, reproduction, etc.). Results of first experiments, claimed microgravity as directly responsible for many aberrations in growth processes which were later ascribed to the indirect effect of microgravity restricting free air convection. Although ionizing radiation is considered one of the main constraints to the long-term permanence of organisms in Space, the effects of Space radiation on plants were overlooked in the past Space experiments. Nevertheless, it has been proved that differently from animals, plants are very resistant to ionizing radiation which can also

induce positive outcomes on plant growth (hormesis). The severity of radiation's effects on plants is dependent upon several factors including radiation-related parameters and organism-related traits.

Experiments of plant growth in Space have demonstrated that, thanks to their adaptive capabilities, plants can grow and successfully reproduce in Space, achieving the seed-to-seed cycle. However, behavior and productivity of plants (including the ratio between edible/not edible biomass) can be significantly altered due to Space factors, thus changing their capability to act as "resources regenerator". Therefore, an integrated understanding of how space factors alter plant growth performance is fundamental in order to: a) define the requirements for plant cultivation in space greenhouses, b) control environmental and cultivation factors, c) maximize the regeneration of resources and minimize the wastes.